

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018 / 2019

PEL0016 - ELECTRICITY AND MAGNETISM

(Foundation in Engineering)

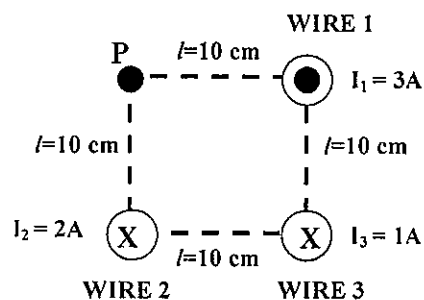
06 MARCH 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

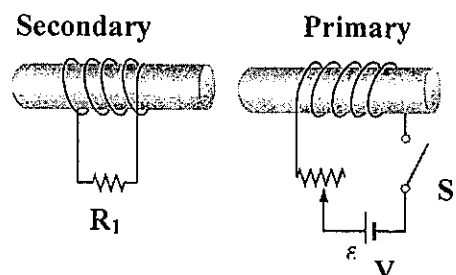
1. This question paper consists of **FIVE (5)** printed pages excluding the cover page and appendices, with **FOUR (4)** questions.
2. Answer **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 (15 marks)

- a) Three parallel wires are located at the corner of a square side of $l = 10$ cm. Each wire carries current as shown in Figure Q1 (a). The currents, I_1 is directed out of the page and the bottom two currents, I_2 and I_3 are directed into the page.
- Draw again Figure Q1 (a) and sketch the magnetic field, $\vec{B}$ exerted on P due to the other three parallel wires. [3 marks]
 - Calculate the net magnetic field, B magnitude exerted on P due to the other three parallel wires. [4 marks]

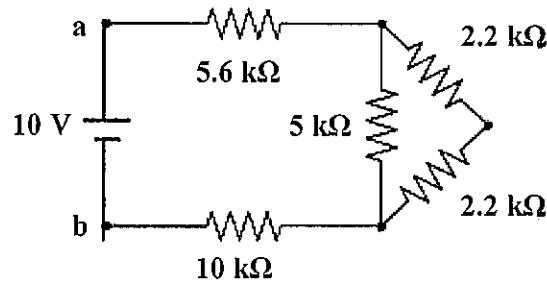
**Figure Q1 (a)**

- b) A vertical straight wire carrying an upward current of 10 A exerts an attractive force per unit length of 5.5×10^{-5} N/m on a second parallel wire located 7.0 cm away. What is the magnitude and direction of current flows in the second wire? [5 marks]
- c) What is the direction of the current induced in the secondary loop in resistor R_1 of Figure Q1(c) for condition stated below:
- Immediately after the switch S_1 is closed? Explain. [1.5 marks]
 - The switch is opened? Explain. [1.5 marks]

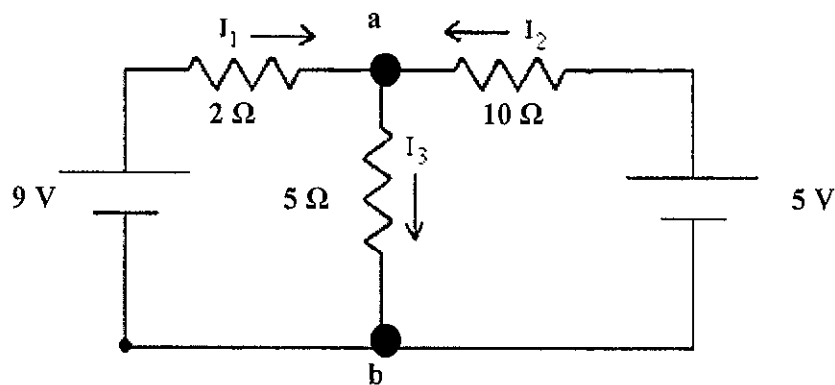
**Figure Q1 (c)****Continued...**

QUESTION 2 (15 marks)

- a) **Figure Q2 (a)** below shows a combination of resistors in a circuit diagram. Calculate the equivalent resistance between terminals a and b. [4 marks]

**Figure Q2 (a)**

- b) i) Use Kirchhoff's Laws to calculate the magnitude current flowing in each resistor, I_1 , I_2 and I_3 as shown in Figure Q2 (b). [7 marks]
- ii) Using Thevenin's equivalent circuit in between point a - b , find the magnitude of current that flow through $5\ \Omega$. Compare and explain the answer from Q2 (b) (i). [4 marks]

**Figure Q2 (b)**

Continued...

QUESTION 3 (10 marks)

- a) An AC generator with a frequency of 10 kHz and an rms voltage of 24 V is connected in series with 2 k Ω resistor and 580 mH inductor.
- What is the power factor for this circuit? [2 marks]
 - What is the average power consumed by this circuit? [2 marks]
- b) In a purely inductive AC circuit, $L=30$ mH and the rms voltage is 150 V with frequency of 80.0Hz.
- Calculate the inductive reactance and rms current in the circuit? [3 marks]
 - If the frequency increases to 8 kHz, determine the rms current in the circuit? [3 marks]

QUESTION 4 (10 marks)

- a) Describe how *n-type* silicon semiconductor could be realised and give two examples of *n-type* dopants. [2 marks]
- b) Illustrate how to forward bias and reversed bias a PN junction with the aid of a diagram. [2 marks]
- c) Figure Q4 (c) shows an amplification circuit using a silicon bipolar-junction transistor (BJT) operating in the common-emitter configuration. The voltage at base with respect to emitter terminal is $V_{BE} = 0.7$ V.

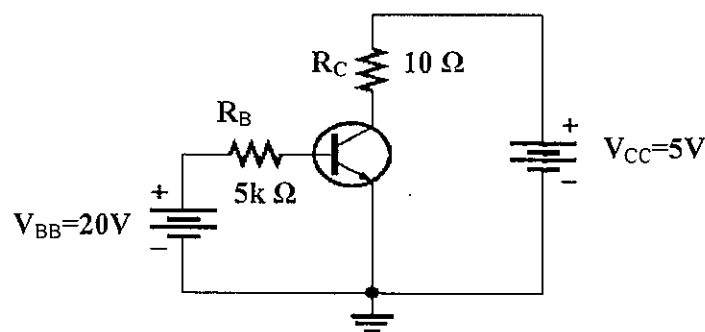


Figure Q4 (c)

If the direct current gain of the transistor is $\beta_{DC} = 100$, determine:

- The base current, I_B , collector current, I_C and emitter current, I_E . [3 marks]
- The voltage at collector with respect to emitter, V_{CE} and voltage at the base, V_B . [3 marks]

End of page

APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass,	m_p	$1.67 \times 10^{-27} \text{ kg}$
Elementary charge	e	$1.602 \times 10^{-19} \text{ C}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_0	-13.6 eV
Boltzmann's constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Compton wavelength	λ_c	$2.426 \times 10^{-12} \text{ m}$
Planck's constant	h	$6.626 \times 10^{-34} \text{ J.s}$
Speed of light in vacuum	c	$3.0 \times 10^8 \text{ m/s}$
Rydberg constant	R_H	$1.097 \times 10^7 \text{ m}^{-1}$
Acceleration due to gravity,	g	9.81 m/s^2
Atomic mass unit (1u)	u	$1.66 \times 10^{-27} \text{ kg}$
Avogadro's number	N_A	$6.023 \times 10^{23} \text{ mol}^{-1}$
Threshold of intensity of hearing	I_0	$1.0 \times 10^{-12} \text{ W/m}^2$
Coulomb constant	k	$8.988 \times 10^9 \text{ N.m}^2/\text{C}^2$
Permittivity of free space	ϵ_0/κ_0	$8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2$
Permeability of free space	μ_0	$4\pi \times 10^{-7} \text{ H/m}$

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc} + 1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1 - \alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N \frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L \frac{dI}{dt}$$

$$\xi = -M \frac{dI}{dt}$$

$$F = BIL \sin \theta$$

$$F = qvB \sin \theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max} \sin \omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x} \right) I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_0 N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_0 N_1 N_2 A}{l}$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$P_t = I_{rms} V_{rms} \cos \phi$$

$$P_r = V_{rms} I_{rms} \sin \phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0 [1 + \alpha(T - T_0)]$$

$$R_T = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA \sin \theta$$

$$U = \frac{1}{2} LI^2$$

$$U = \frac{1}{2} B^2 A \frac{l}{\mu_0}$$

$$V_H = Bvd$$

$$V = V_{max} \sin \omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T} \right) V_s$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi fL$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B \cdot dl = \mu_0 I$$

$$d\mathbf{B} = \frac{\mu_0 I}{4\pi} \frac{d\ell \times \hat{r}}{r^2}$$

$$\Phi_B = BA \cos \theta$$

$$\cos \phi = \frac{R}{Z}$$

$$\tan \phi = \frac{X_L - X_C}{R}$$

